Research in Provincial Universities
as a new stage of science development in Russia.

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Abstract
The tremendous social and political changes that culminated in the Soviet Union's dissolution had a great impact on the Russian science community. Due to the Russian transformation to a market economy a new model of R&D emerged on the basis of the higher education system (R&D in universities). This paper is part of a project, the main goal of which is to analyze the impact on competitive funding on R&D in provincial universities; the distribution of funding by the Russian Foundation for Basic Research; and level of cross-sectoral and international collaboration. The paper gives a descriptive overview on R&D conducted at the 380 provincial universities, 1,230 research projects and 11,771 individuals. Our data demonstrated a positive tendency in demographic statistics in provinces. A map of intra-national collaboration taking place in 1997-99 in provincial universities situated in different economic regions was designed. Our data show a strong collaboration inside of the regions, which is an important factor of sustainability. Russian international collaboration depended heavily on financial support of foreign counties.

1. Introduction

Russian science has excellent track records of world-class scientific research, which was conducted in the research institutes under the umbrella of the Academy of Science of the USSR (now the Russian Academy of Sciences). Universities and higher education institutes were involved in teaching students and played an insignificant role in basic research (exceptions were Moscow State University and St-Petersburg State University).

The tremendous social-political changes that culminated in the Soviet Union's dissolution had a great impact on the Russian science community. Due to the Russian transformation to a market economy a new model of R&D emerged on the basis of the higher education system (R&D in universities). There are three

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kinds of agencies involved in the higher education system in Russia: universities, higher education institutes and academies (not to be confused with the Russian Academy of Sciences). To facilitate the reading, we call all of them "universities".

The development of basic research became an important factor of competition among universities. As the higher education system is going through speedy changes, it attracts financial resources for its transformation from the population. Since 1996, special local grant programs have emerged. The Russian Foundation for Basic Research (RFBR) and the governments of 41 regions funded these programs (there are 89 economic regions in Russia). These joint programs focused on research subjects, which could be important for the local economy. As a consequence of the new government funding policy, particularly the multi-channel system of competitive funding, the provincial universities became serious players and partners of academic institutions and industry inside of Russia as much as outside.

Moreover, in the provinces the new local elite became aware of the necessity of science for stability and prosperity in the region. Life in the provinces is much harder and local universities face more financial problems than their colleagues in megapolis. Today, government support covers only office expenses (including utilities) and a part of salary costs. Salaries of scientists are on a low level and grant money is essential for support of scientists' families. Another observation concerns the growing interest in regional collaboration. In 1995, less than one-quarter of all academic papers involved cross-sectorial collaboration in the USA (Science &Technology Indicators, 1998). A preliminary analysis of selected data from the RFBR database has shown a similar tendency. Small universities rely more on external collaboration. In 1998, about thirty per cent of the Russian articles in SCI journals had involved international collaboration.

Recent studies (Y.Okubo, R.Gusmao, A.Sigogneau, M..Zitt, 2000) underlined a special pattern of collaboration in the regions situated at the national border. From our own experience we knew about some special links among Russian Far East universities and Japanese and Chinese universities. However, the phenomenon needs deeper and more sophisticated analysis of the social and cognitive mechanisms that shape the scientific practice of today. This paper is part of a project, the main goal of which is to investigate collaboration as a main factor of the new role of regional universities on the Russian science stage and on the impact of these changes on the research being done in the Russian provinces.

2. Method

The study is based on the bibliometric indicators derived from the Russian database on grant distribution "GRANT", which was developed by the RFBR. The database, covering the period 1994 to 2000, contains records on 115,000 researchers, about 23,000 projects and 1,500 organisations in the natural, applied, and social sciences. The research projects were carried out by 486 universities (there were in total five hundred ninety universities according to the statistical Directory " Science in Russia, 2000"), of which 380 are situated in the Russian provinces. The database includes information about the funded project, name and address of the organization where research was done, the type of organization (research institute, educational organization or private facility) and bibliographic information on each publication (including an abstract) published by the grantees as a result of the project. Since the majority of Russian research scholars engaged in basic research have been supported

by RFBR this information enabled us to estimate the progress made in basic research in regional universities.

The following indicators were used for evaluation:

- Total number of applications and grants for each university;
- Distribution of applications and grants by field of science
- Number of researchers who applied for a grant in each region
- International collaborative output (CO) by each university, region and country
- Country's share of total CO in a specific field of science

Special attention was given to the verification of names and addresses of universities and higher education institutes, which appeared in the database. We want to underline that during last seven years about 70 % of universities changed their name. Extensive checking was done to clean the database. The Science Citation Index database via DIALOG for 1999 and 2000 was used as a reference instrument. Research projects involving at least one person affiliated with a university located outside of the Moscow and St-Petersburg regions were identified. Subsequently, the files of universities were compiled.

3. Results and Discussion

The upgraded, verified database includes information about 11,000 researchers, 6,000 applications, more than 1,200 research projects, about four hundred provincial universities and more than 4,300 publications. The research projects have been sorted by field of science, university and region. We used the same classification of fields of science as INTAS: M - mathematics, mechanics and computer science; P - physics and astronomy; C - chemistry; L - life sciences including biomedicine; ES - earth and environment science.

To get more precise knowledge about research development in the provinces we based our analysis on both applications and grants. We assume that an application for a grant is a sign of research activity in a university. Statistical data about the distribution of applications and grants over the universities for 1995-1999 have been collected and presented in Figure 1. In 1995-99, the principal investigators (PI) affiliated with universities carried out 1,230 research projects in 229 provincial universities. However, the number of universities, from which researchers participated in RFBR projects as member of a research team, was 380. The top thirty universities received about 80 per cent of the grants given to regional universities in this period. For all universities the average success rate (the ratio between the number of grants and the number of applications) was 0.22. This figure is lower than for a whole pool of grant-holders. A low level of research activity could be related to a sharp growth of the teachers' burden since 1992. As an example, during the period of 1993-99 the number of students increased by 47 per cent (from 2,54 millions to 3.73 millions). However, the number of teachers increased by only seven per cent (from 239,9 thousands to 255,9 thousands). We believe that with such a student-professor ratio research activity becomes a rival of teaching.

A growth of student numbers in provincial universities could be partly attributed to economic circumstances. Due to a high cost of living in megapolis young people cannot afford to live and study in Moscow or St-Petersburg. They have to live and study in the area in which their family lives. Professional teachers do not move from Moscow or St-Petersburg to the provinces. This is why the number of skilled teachers in the provinces is limited.

In the period 1995-99, the number of participants in the projects submitted from provincial universities was 19,998. However, among these researchers several individuals applied for more than one grant during these years. Therefore the number of individuals involved in competition was 11,771.
Cross-sectoral collaboration is viewed as a vehicle moving research results toward practical application. We identified 1337 individuals who were invited to participate in university projects. Our findings demonstrated that provincial universities mainly collaborated with each other. Despite Moscow State University's (MSU) exceptional position among universities considering its high level of basic research, the collaboration with the MSU was only 1.8 per cents. Cross-sectoral collaboration was also on a low level.
We then analyzed the distribution of applications and grants over disciplines in 1997-1999. The findings are shown in **Figure 2.**
We observed an increasing number of applications and grants in the field of ***Mathematics and Computer Sciences (M)***. It is clear that the growth rate of ***M*** was significantly higher for grants than for applications. Further study of the reasons for the observed trend showed that basic research in the provinces is quite different from that in megapolis where physics/astronomy is the strongest discipline. This could be a specific feature of research in pure mathematics. Also, there are strong schools for mathematics and computer science in the universities of Kazan, Nizhniy -Novgorod and Rostov.
In ***Physics*** and ***Life Sciences*** we observe a decline in success rate. This fact could be attributed as a consequence of the economic crisis, which happened in 1998.

Demographic data of the participants were collected and analysed. The age distribution of the grantees in 1997 and in 2002 is shown in Figure 3. According to our finding the percentage going to young age group had increased steadily from 35 % in 1997 to up 41 % in 2002. This is a positive sign, showing that in the provinces young people became attracted to science. The average age of the project leaders was compared with the average age of university teachers (all of whom have a Ph.D. or Professor title) from two hundred universities (www.informika.ru). These data show that on average a project leader was five to seven years older than the average teacher. However, principal investigators as usually bring a team much younger. These findings demonstrate a strong influence of a university hierarchy.
Study of the gender distribution of researchers demonstrated the dominating role of male researchers. The share of female researchers was 12.2 per cent, ten per cent points lower than share of female researchers in the total pool of the RFBR grantees. (Markusova V. A., Minin V.A., Libkind A.N., Arapov M.V., Jansz M., Tijssen R, 2001). On the other hand it may not be so surprising considering the high share of applications and grants in mathematics (more than 50 per cents).

From the collected data we designed a map of intra-national collaboration taking place in 1997-99 in provincial universities situated in different economic regions. The strength of collaboration was evaluated by looking at the number of researchers involved in collaborative efforts. These data are shown in Table 1**.** Among eleven economic regions we identified only a few regions with strong ties. These regions have geographical proximity: North Caucasus and Povolzh'e (along the Volga River), Western Siberia and Eastern Siberia. Our data show a strong collaboration within the regions, which is an important factor of sustainability. The regions have less job opportunities than a metropolitan area and the involvement in collaborative

research helps to build human and professional connections that have a positive impact on sustainability in the local community.

International collaboration was studied on the basis of the universities' grantee output in 1999. A total of 459 unique collaborative publications (CP) were evaluated, which involved collaboration with researchers from 43 countries. The share of these papers was about 10 % of the universities' grantee output (4338 papers) in 1999.

The distribution of CP by field of science indicated the strongest collaboration on mathematics and physics – the share of each field was about 35 per cent. Chemistry's share was about 23 per cent. These data are displayed in Figure 4. It is a well-known that in the former USSR, physics, particularly nuclear physics and astrophysics (due to their military applications), was a lavishly funded and supported discipline benefiting from the powerful school of first-class Russian scholars and still appreciated by the world scientific community. Russia also has developed a great tradition in mathematics dating back to Euler and the Bernoullis in the early 18th century. The famous mathematician N.I.Lobachevsky was Professor in Kazan University in the end of the nineteenth century. Before the Revolution Kazan' was the city with the greatest concentration of mathematical talents anywhere. Since that time many universities in the Povolzh'e region developed good schools on mathematics.

The distribution of CP by economic regions is presented in Figure 5**.** Our data show that *eleven* economic regions only *nine* were involved in international collaboration. Two regions, the Far Eastern region and the Northern (one collaborative paper) region were practically absent from the map. This was a surprising result because we know about many bilateral projects conducted by researchers from the Far Eastern Branch (FEB) of the Russian Academy of Sciences (RAS) with universities in China. Presumably the FEB researchers who are part time teachers at the Far East State University (situated in Vladivostok), assigned papers resulting from this collaboration to the FEB. The strongest players among the economic regions were Povolzh'e (23.3 % of CP), Ural (18.7 %), Volgo-Vyatskyi and Northern Caucasus (each approximately 12 %), Central Chernozem'e and West Siberian (each approximately 11 %). In view of the last ten years of Russian struggle with Chechen guerrillas, it seems a little bit strange at the first glance that the Northern-Caucasian region was among the regions with a strong sign of international collaboration. However, during the World War I, in 1914, the Warsaw University was transferred to Rostov. After the October Revolution in 1917, this university was renamed the Rostov Sate University (RSU). The excellent teachers made this university a pivoting point of higher education for the whole region. A few new universities, which were founded in that region after World War II have strong ties with the RSU and follow its international collaboration pattern. In an interview given to us by the provost of the RSU, professor A.Zhdanov underlined that university policy was focused to attract more young researchers. He said that the RSU annually hosts a few international conferences, helping researchers to develop and enhance international collaboration.

The distribution of collaborative papers (CP) by economic region and country is shown in **Figure 6**. It is clear that the USA, Germany, France, England, Italy, and Japan were the most favored collaborative partners. Poland and Ukraine are the countries, which traditionally were strongly involved in collaboration with Russian

scientists. However, each country's share of CP did not exceed 3 %. Both collaborated with the same regions bordering on the Ukraine: Povolzh'e, North Caucasian and Central Chernozem'e. The USA, Germany and France demonstrated more diversified collaboration patterns (collaboration with all ten regions) than England and Italy (collaboration with four regions) or China, Ukraine and Poland (collaboration with three regions)**.** The last three countries had a frontier economic region as main collaborator.

We want to emphasize that due to economic turmoil Russian international collaboration depended heavily on financial support of foreign counties. US and German funding agencies (the US Civilian Research and Development Foundation and German Max Plank Society) have special programs for provincial universities. These programs gave an impetus to bilateral collaboration. Poland and Ukraine demonstrated a similar pattern of collaboration by region. We assume that the low level of collaboration in the Central and North-Western economic regions was a consequence of exception from the list of universities Moscow State University and St-Petersburg State University located in these regions. Both universities produced a significant amount of CP (Markusova V.A., Minin V.A., Libkind A.N., Arapov M.V., 2001).

Due to history of higher education and industrial development of the regions during the Soviet era, each region was focused on international collaboration in the field of science, which was more advanced there. The Ural region was the strongest player in collaboration on chemistry (share 31 %), Povolzh'e on mathematics (share 28 %); Volgo-Vyatsky region on physics and astronomy (share 23 %), Eastern Siberia on earth sciences (share 45 %). The Northern region was the strongest player in collaboration on life sciences (31 %). Nevertheless, the collaboration by country and field of science revealed different players. E.g. China was focused on collaboration in earth and environmental sciences, Finland on life sciences, the USA on chemistry, physics and mathematics.

We investigated the collaboration patterns of few top universities: Kazan' State University (KSU), Voronezh State University (VSU), Nizhegorodsky State University (NSU), and Rostov State University (RSU. Our findings reveal each university's preference in collaborative partners (See Figure 7):
Researchers from the KSU published half of their CP with colleagues from Germany (20%), Japan (15 %) and the USA. The VSU had a strong collaboration with researchers from the USA (26%), Italy (20%) and France (14%). Italy (25%), Spain (13%) and Georgia (13%), a former Soviet Union Republic, became the main collaborator for researchers from the NSU. The RSU had as main partners France (20%), USA (15%) and Germany (15 %).
The question why people collaborate and how they find collaborative partners was discussed (D.Beaver, 2000). To trace the starting point of provincial universities' collaboration we organized a survey among grantees. A questionnaire was developed and about 1,500 copies were distributed by mail. At the moment of submission of this paper we had received about 387 replays. We hope to receive more answers in next few months in order to have enough data to discuss this issue at the ISSI Conference in August 2003 in Beijing.

4. Conclusions

This paper provides an overview of an assessment of R&D activity in the Russian provinces. The centers of excellence among universities were identified. Our data show a strong collaboration inside of the regions, which is an important factor of sustainability. The analysis of papers resulting from international collaboration (459 papers) revealed that among eleven economic regions, the Northern and Far Eastern regions did not show any collaboration The other nine regions developed collaboration with 43 countries. In some regions, the pattern of this collaboration reflects historical and cultural traditions. Our analysis and the survey being conducted at the moment will shed additional light on the nature of international collaboration. The resulting information could be used by local authorities and policy makers to mobilize resources for improving the higher education system, to enhance international collaboration and mobility, and to develop long-range planning and guidelines for research investment in the provinces.

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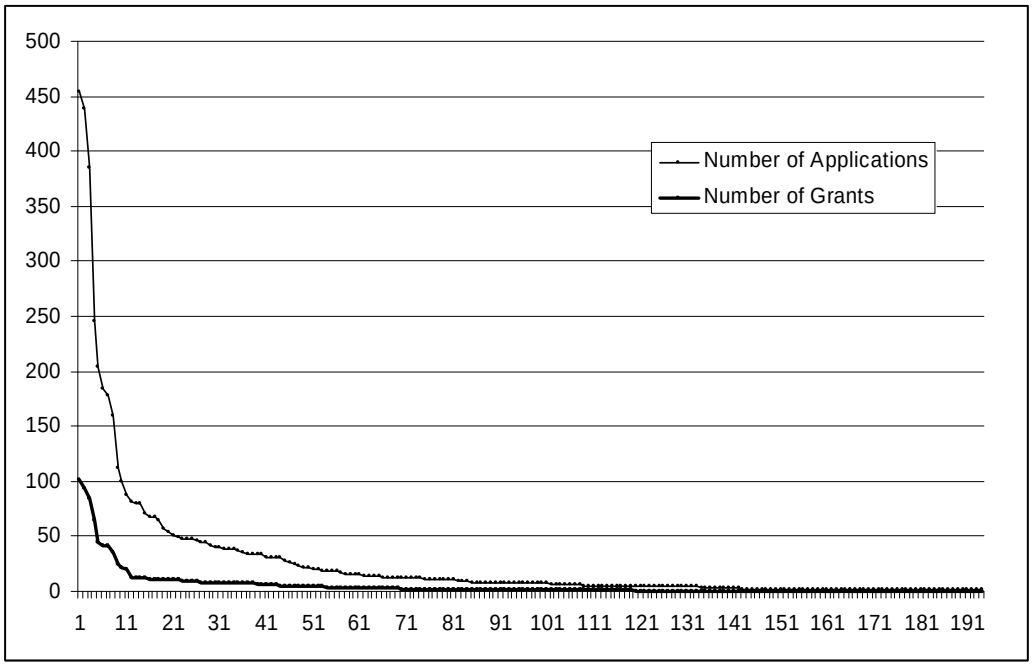


Figure 1 Applications and grants distribution by provincial universities, 1995-1999

Figure 2. Distribution of Applications and Grants by Field of Science and Years
1997 - applications - 1166, grants - 203;
1998 - applicatations - 1109, grants - 240;
1999 - applications - 1013, grant numb. - 234)

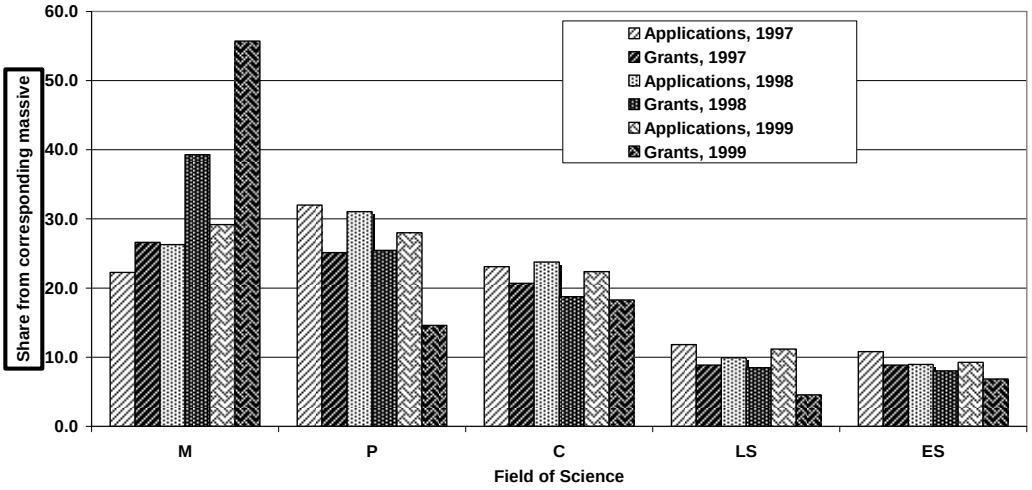


Figure 2 Distribution of applications and grants by field of science and years 1997-applications-1166, grants-203; 1998-applications-1109, grants-240; 1999-applications-1013, grants-234

Figure 3. Researchers' Distribution by Age (applications)

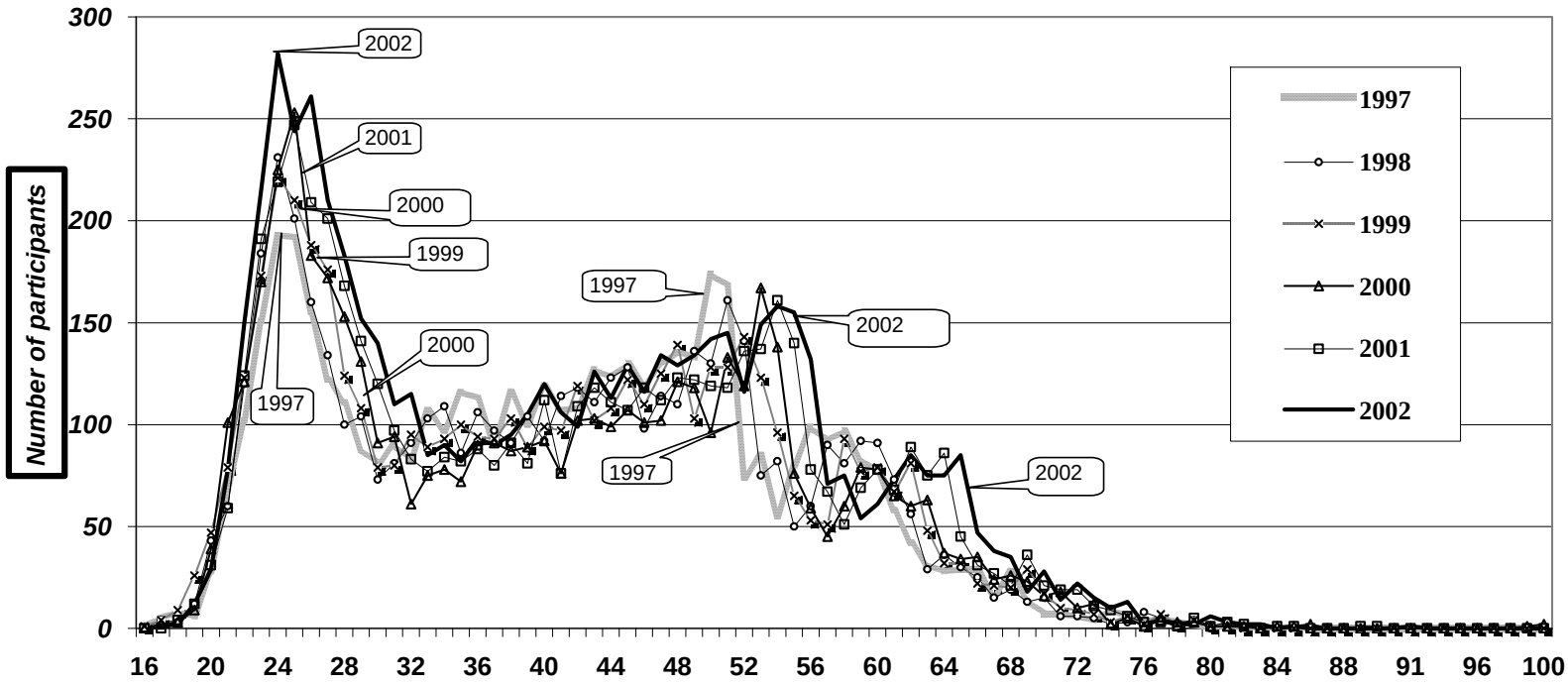


Figure 4. Distribution of Collaborative papers by Field of Science

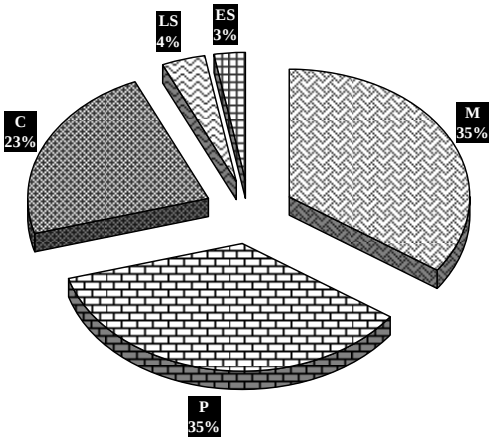


Figure 5. Distribution of Collaborated Papers by Regions

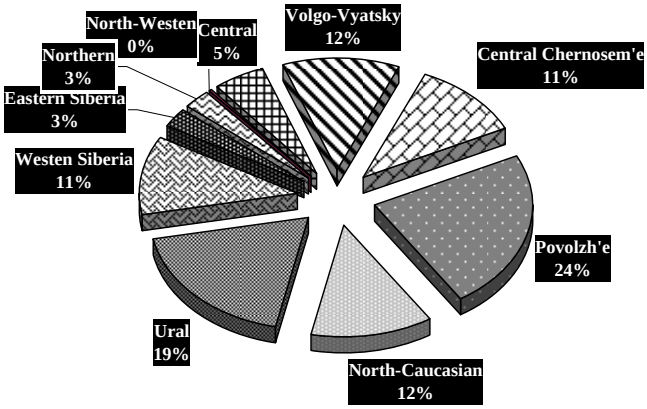


Figure 6. International Collaboration by Country and Economic Regions

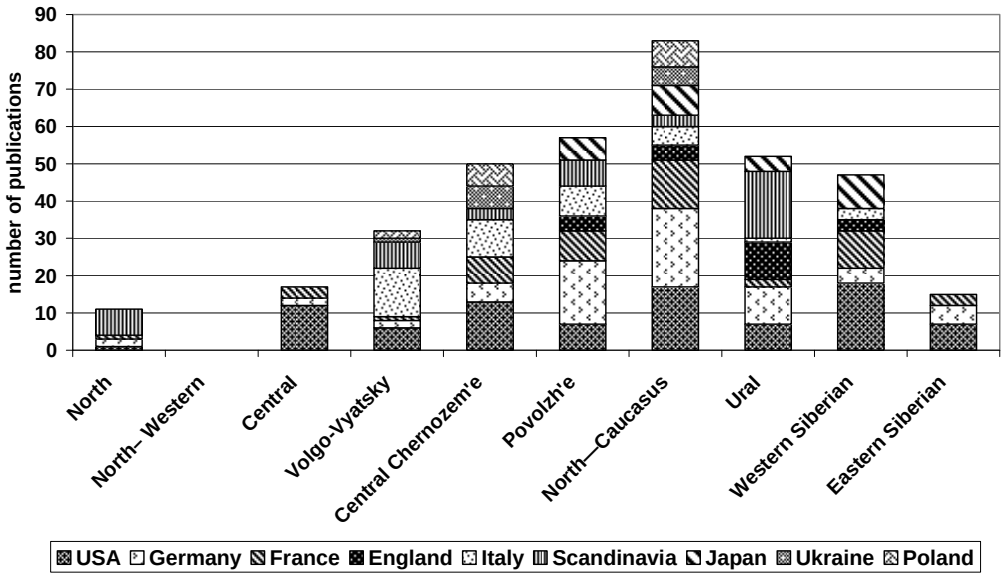


Figure 7a. Kazansky State University, 1999

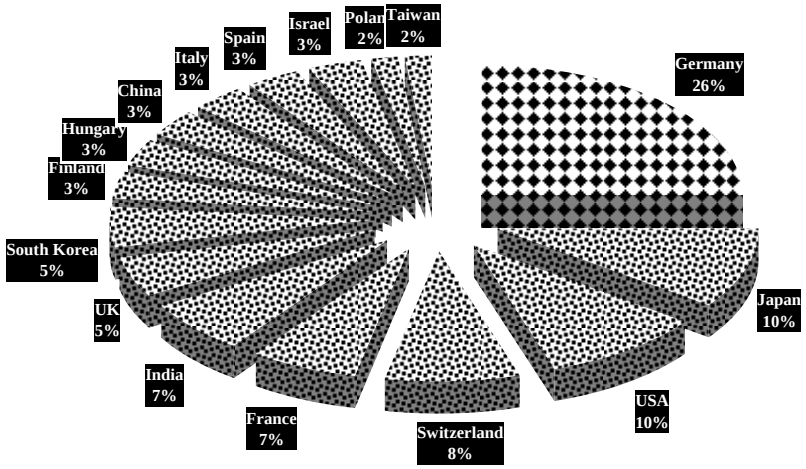


Figure 7b. Voronezh State University, 1999

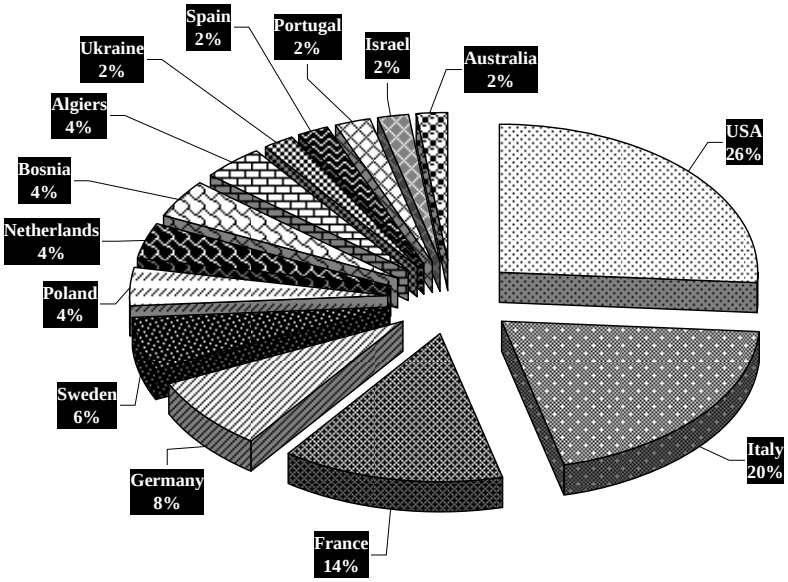


Figure 7c. Nizhegorodsky State University

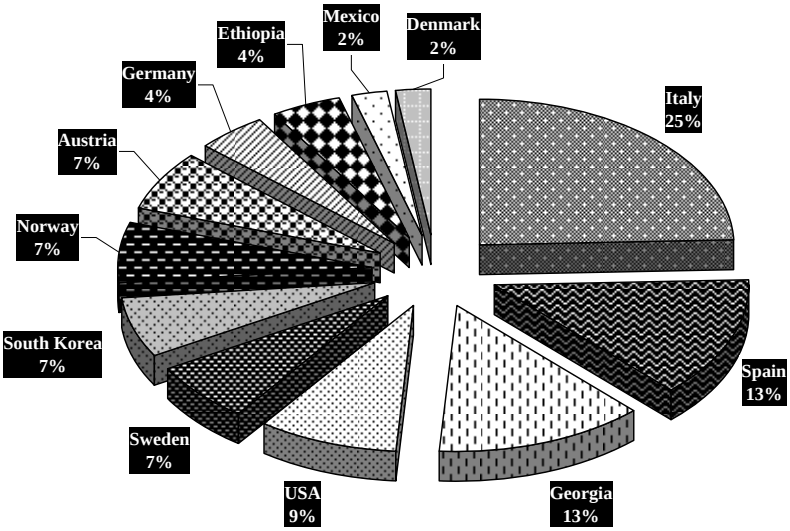
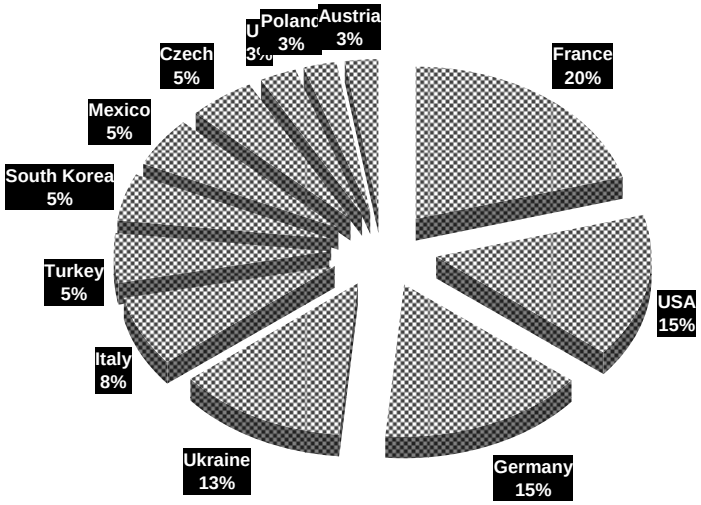


Figure 7d. Rostovsky State University, 1999



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